The Effect of Cavitation in Propeller – Rudder – Hull Interaction

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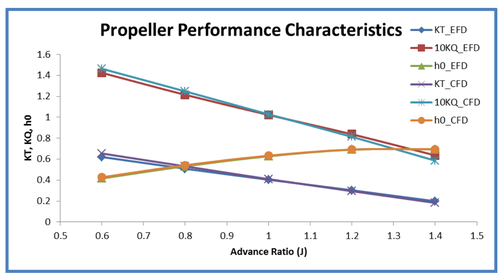
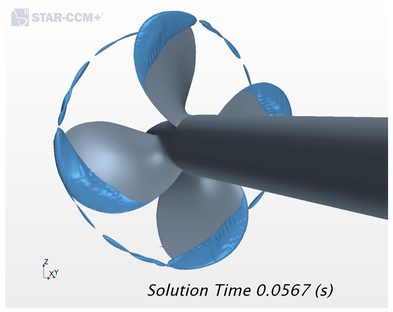
Introduction

This study develops a new method for investigation of cavitation in terms of propeller rudder and hull interaction. Influenced by the interaction, the cavitation will be examined using computational fluid dynamic methods. First, whole system including propeller rudder and hull will be divided into small parts to simulate step by step. These steps include open water simulations for the propeller, analyses of the propeller in the cavitating conditions, cavitation analyses which is including propeller and rudder will be realized respectively in model scale as the validation studies. Next, the whole system will be analyzed in model scale and full scale to predict cavitation patterns on propeller and on rudder. Especially, simulating the influence of operating propeller on rudder will be the most important and novel part of this study. During the analyses, different solving models i.e. RANS, DES and LES will be used for the comparison with each other. As a result, a method will be proposed to simulate and predict the cavitation on rudder placed in the wake of an operating propeller.

Material & Methods

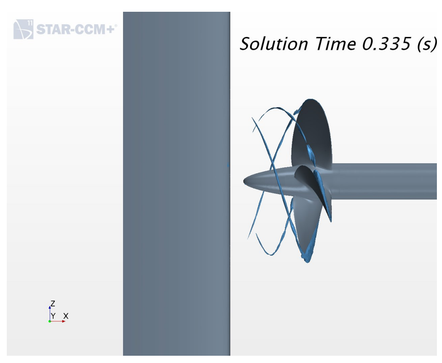
Open Water Propeller Analysis



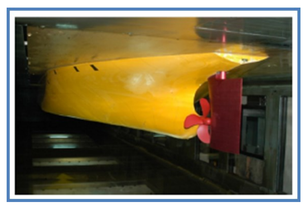


Propeller Cavitation Analysis in Cavitation Tunnel Conditions

Propeller Cavitation Analysis with Rudder in Cavitation Tunnel Conditions

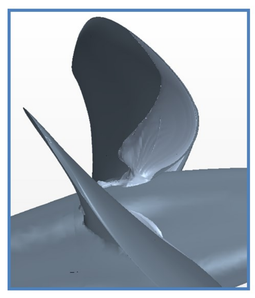


Model & Full Scale Cavitation Analysis including Propeller, Rudder & Hull

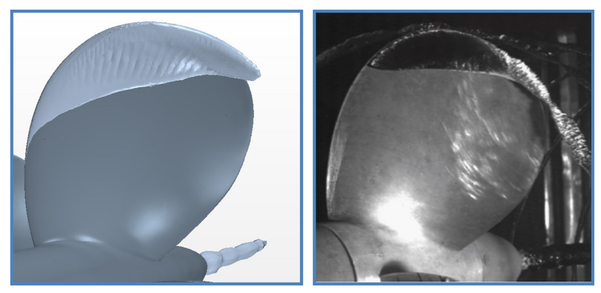


Results

Cavitation Pattern on Propeller Blade Surfaces

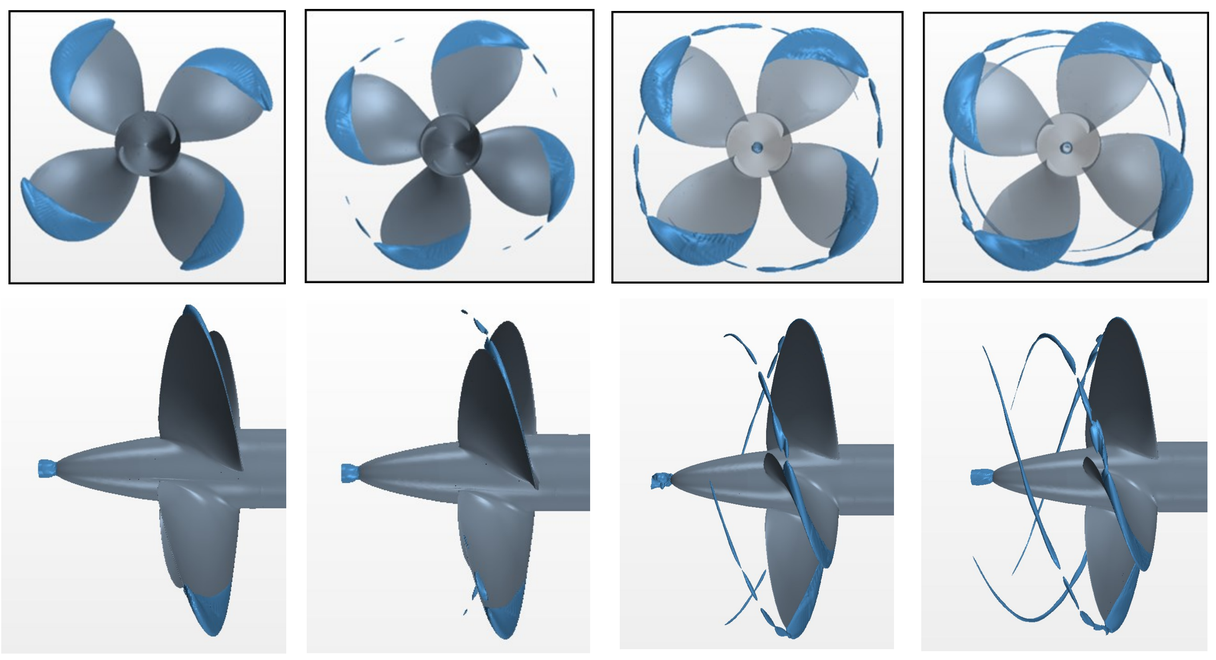


PPTC Propeller with Shaft Inclination

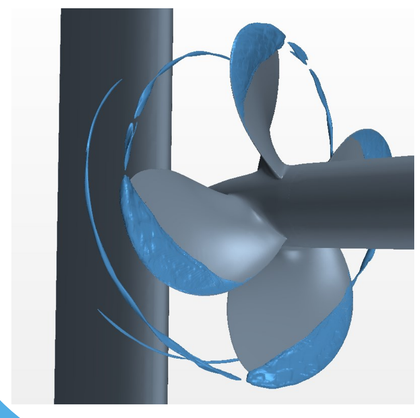


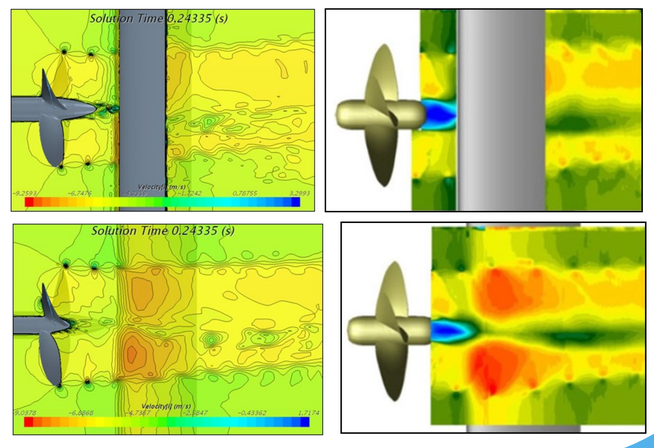
INSEAN E779A Propeller

Tip Vortex Cavitation Extension



Interaction between Cavitating Propeller and Rudder





Conclusion

- CFD results showed good agreement with EFD results for standard test propeller in non-cavitating and cavitating conditions.
- New mesh refinement approach was very effective in simulating tip vortex cavitation in propeller's slipstream.
- Interaction between cavitating propeller and rudder was evaluated and the comparison between CFD and EFD showed good agreement.
- These improvements will be used for investigation of propeller, rudder and hull interaction in model and full scale in future.

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